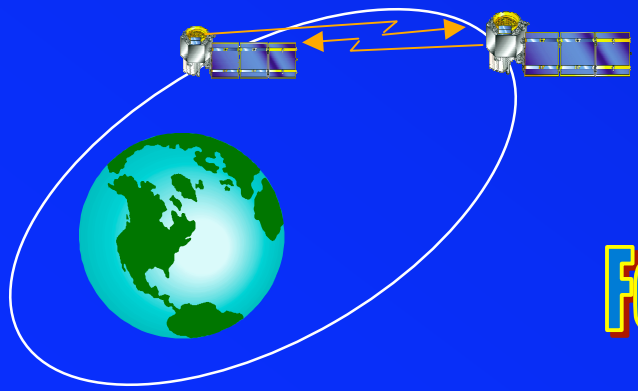
INTELLIGENT COLLABORATIVE AND AUTONOMY TESTBED (ICAT)

New Millennium Architecture Team



February 25, 2003

BACKGROUND

- **Over the last year, the NMP Architecture Team has studied a series of Mission Scenarios that could support flight validation in 3 of the 4 Code Y Technology Thrust Areas:**

Technology Thrust Area	Mission Scenario results
Deployable Microwave Antennas	Identified mission characteristics for 3 science applications; considered carrier options; partnering with other projects is problematic for an antenna-only validation
Laser/lidar and Optical Systems	Only preliminary look taken; need better understanding of capability needs.
Intelligent Distributed Systems	Study considered a series (5) of validations with increasing complexity. A precursor to the missions is a testbed concept.
Information Knowledge Capture	Not addressed by NMP.

The studies were exploratory and created an initial reference from which future NMP ESE flight validations might be designed or assessed.

BACKGROUND, CONT'D

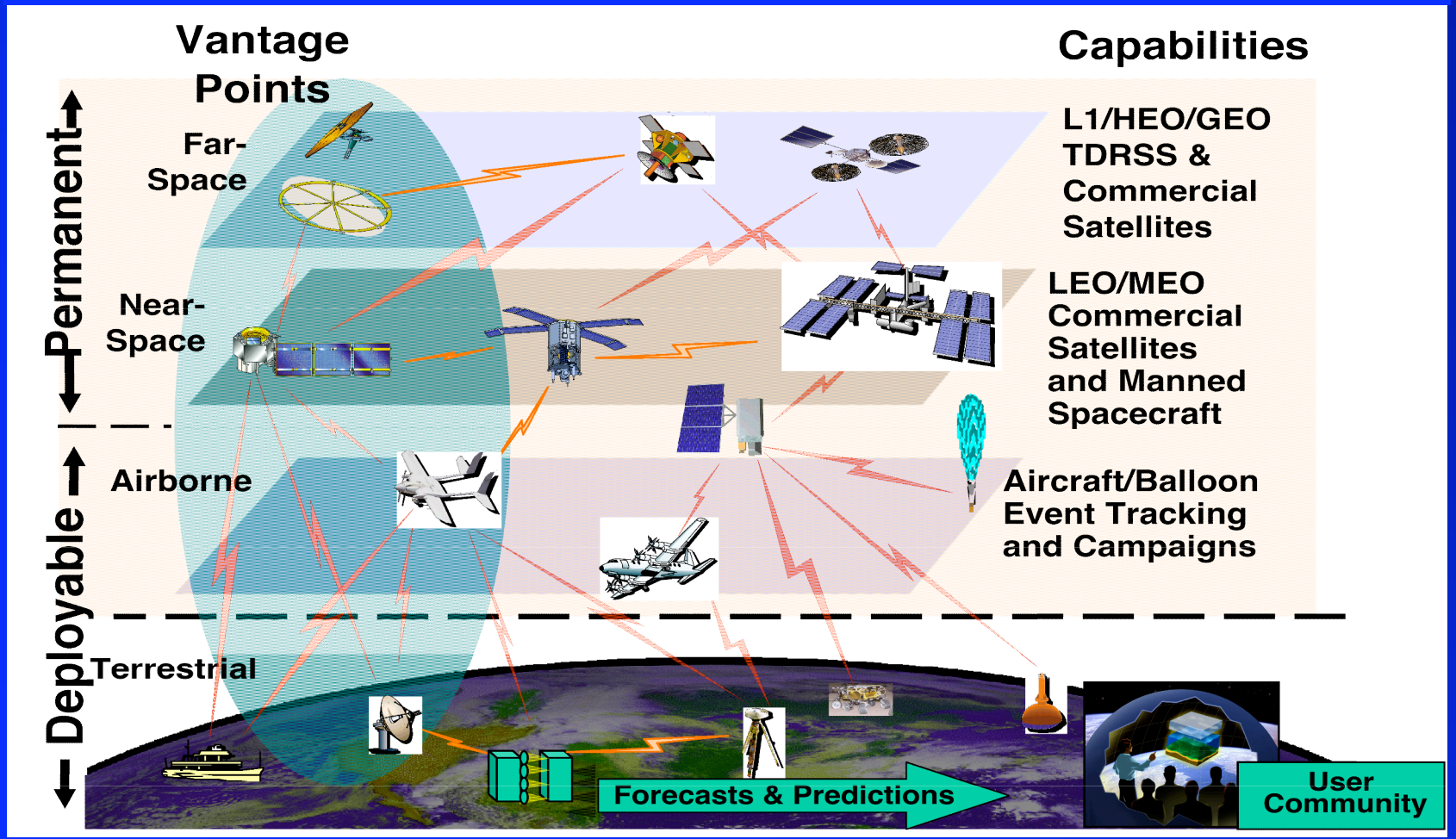
- **Current Status of Technology Thrust Areas**

Technology Thrust Area	Funding Organization
Deployable Microwave Antennas	DARPA
Laser/lidar and Optical Systems	NASA
Intelligent Distributed Systems	NASA-NMP feasibility studies
Information Knowledge Capture	NASA-ESTO

ICAT addresses only the Intelligent distributed systems

BACKGROUND , CONT'D

There have been a number of Advanced Studies for Intelligent Distributed Systems, as exemplified by this familiar graphic.



BACKGROUND, CONT'D

- DOD/NASA next-generation (TDRSS) communications infrastructure studies began last year, and will lead to infrastructure implementation in 10-15 years. Any requirements and technology capability definitions are yet in very early stages, and preclude flight testing in the near term.

- This next-generation infrastructure will be key to supporting future ESE science missions with their large data exchanges, autonomous functions, and communications protocols.

- Many autonomy algorithms and communications protocols, currently in development, will require in-flight validation before there is confidence in using them.

- An in-space testbed, established in 2006-2008, would enable the flight validation for IDS and autonomy technologies as they mature in the next few years.

APPROACH

- A low-level funding experiment, the ICAT begins as a module that is competed by NMP. The module can be installed on any Earth orbiting spacecraft - with minimum impact - that would make the host a node in the testbed.
- The module is accommodated on several ESE science missions launching in 2006-2008, adding a node to the ICAT network with each launch.
- The module is capable of low data rate communications, location identification and message processing for experiments in collaborative science, formation flying, and autonomous functions.
- Once in place, the ICAT testbed is available for use through competitive NRA solicitations.

STRAWMAN DESIGN

- A strawman ICAT mission scenario has been developed (based in large part on current SDNITS* mission scenarios) as part of a feasibility study, and now is ready for critical review before "going public".

- The strawman design builds upon the growing number of 5-kg, 5-W modules flown, as well as considering an augmentation of the module capability:
  - Type I: most common unit, used on most LEO spacecraft. Performs simple CDMA encoding and uses 2W X-band crosslink / uplink / downlink
  - Type II: Used as central node, performs CDMA decode function and can link to 100 simultaneous users. Main use as GEO node, may also be a centralized node for a specific mission application (say in the AM/PM trains, clustered spacecraft mission, etc.)

- ESTO's recently-flown LPT module is a precursor for this ICAT module

* Smart Data Node in the Sky

CURRENT PLANS

- Seek inputs from the community to confirm the testbed capability needs.
- Propose to conduct a workshop to obtain input from science and technology communities to help refine the multi-spacecraft testbed architecture trades and the requirements for the ICAT.
- Small team composed of 3-4 people (technologist, architect, scientist) to meet with: scientist, technologists, architects, and mission operations experts to flesh out issues to be addressed at a public.
- Public Workshop open to all interested parties.

LOGISTICS

- **Overview of workshop**
  - Presentation of ESV of distributed intelligence & multi-satellite data collection
  - Presentation of strawman testbed concept by NMP Architecture Team
  - Splinter sessions to address five top-level questions
  - Reports to plenary and iteration of ICAT concept
- **Target date**
  - Pre-workshop traveling meeting (April 2003)
  - 2-day workshop (May-June)
- **Location**: Washington D.C. area

POTENTIAL WORKSHOP PARTICIPANTS

- Technologists
  - NASA
  - NRO, DARPA
  - Industry
  - Universities
- Advanced Studies Teams
  - GSFC
  - JPL
  - DoD, NOAA
- Mission operations Specialists
  - GSFC
  - JPL
  - DoD
  - Commercial
  - Network Security

Perhaps a workshop co-sponsor from DoD?

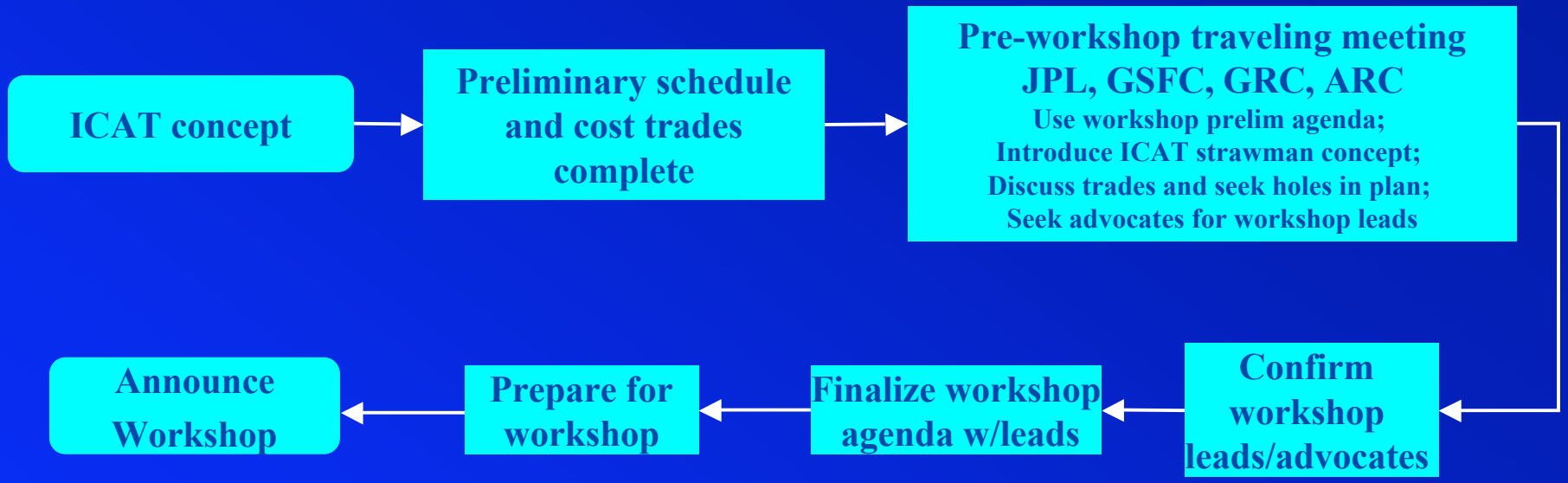
QUESTIONS FOR THE WORKSHOP

- Who will be the main users of ICAT ?
- Identify the participants & their needs
  - Identify commonality with non-NASA (DoD or commercial) future missions or needs
  - Consider priorities for flight validation
  - Consider dependencies of one technology on another
- What are the key system drivers, trades and uses of the ICAT testbed ?
  - Range of testing
  - Simulated vs. actual commanding
  - Minimum IACT capabilities required
  - Optimum number of nodes (Value of 1 node. 2 nodes, 3 nodes, etc.)
  - Map scenario of the testbed evolution from 1 node to 2 nodes, from 2 to 3, etc

QUESTIONS FOR THE WORKSHOP, CONT'D

- How to interface with each host spacecraft/mission?
  - Accommodation resources
  - Integration and Test
  - Operations
- How might the testbed facility be organized and operated?
  - Chronology of experiment plans for each technology.
  - Roles and responsibilities of participants
  - Identify needs for TDRSS, DSN and other ground station resources

PROCESS FLOW CHART



Potential leads for workshop:

LEAD	WORKSHOP SESSION
NMP	1. Strawman scenario for ICAT testbed
NMP (Lansing)	2. Technologies that can be tested in (2006-2008 +) readiness, requirements, constraints
ESTO	3. Architecture scaling
NMP	4. strategic alliances DSN, TDRSS, Mars Network
GSFC NMP	5. Testbed operational scenarios

ICAT Workshop: Invites science, technology and industry participants that want to either build or use the ICAT